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# SCIENCE

FRIDAY, OCTOBER 29, 1915

THE IMPORTANCE OF GEOGRAPHICAL RE-  
SEARCH<sup>1</sup>

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THIS year, when the British Association is holding its meeting in times of the utmost gravity, the changed conditions which have been brought about by this war must occupy the attention of all the sections to a greater or less extent, and our attention is being called to many fields in which our activities have been less marked or more restricted than they might have been, and where more serious study is to be desired. The same introspection may be usefully exercised in geography, for although that branch of knowledge has undoubtedly advanced in a remarkable degree during the last few decades, we have certainly allowed some parts of the subject to receive inadequate attention as compared with others, and the necessity for more serious study of many of its problems is abundantly evident.

Nor is the present occasion ill adapted to such an examination of our position, for when the British Association last met in this city, now twenty-eight years ago, the president of this section, General Sir Charles Warren, urged in his address the importance of a full recognition of geography in education on the grounds that a thorough knowledge of it is required in every branch of life, and is nowhere more important than in diplomacy, politics and administration.

Matters have certainly advanced greatly since that time, and a much fuller appreci-

MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

<sup>1</sup> Presidential address to the Geographical Section of the British Association, Manchester, September, 1915.

ation of geography now exists than that which formerly prevailed. At the time of the address to which I have referred the serious study of geography in this country was on the eve of important developments. The Council of the Royal Geographical Society had for some time been urging the importance of geography being studied at the universities so that there should be an opportunity for advanced students to qualify themselves as scientific geographers by study and original research in the subject. The time had arrived for this ideal to become an accomplished fact, and in the following year, 1888, a reader in geography was appointed at Oxford University, and a lectureship in the same subject was established at Cambridge. Since then the advance has been steady and continuous not only in the increased attention given to the subject, but also in the way in which it is treated. The earlier bald and unattractive statistical presentation of the subject has now been almost everywhere replaced by a more intelligent treatment of it, in which the influences of the various environments upon the life which inhabits a region are appreciated, and the responses to such influences are followed up. Instruction in the subject is given by those who have seriously studied it, who realize its importance, and who are in a position to train up new scientific workers in the field of geography. Though much remains to be done, there should be now a steady output of geographical investigators capable of providing an ever-increasing supply of carefully observed data, which they will have classified methodically and discussed critically, in order that these may be utilized to form sound generalizations as to their relationships and sequence in accordance with the method which is employed in all scientific work.

In order that we may see what advance

has been made in the scientific study of geography in this country during the last quarter of a century, we must turn to the results that have been attained by the activity of geographical investigators who have devoted themselves to the serious study of various phenomena, and the detailed investigation of particular regions. If we do so I think that we must admit that the number of original investigators in scientific geography who are extending its scope in this way is not so large as it might be, nor are we yet utilizing sufficiently all the material which is available to us. Any one who will examine the geographical material which has been published in any period which he may select for review will find that purely descriptive treatment still far outweighs the analytical treatment which alone can lead to definite advances in scientific geography. If pleasing descriptions of this or that locality are sought for, they are for the most part to be found readily in the very large amount of such material that has been and is being published each year by residents, travelers and explorers; but if information is desired in the prosecution of a piece of geographical research, we are checked by the lack of precise details. Few of this class of descriptions are sufficiently definite to enable the necessary comparisons to be made between one locality and others which are similarly situated; thoroughly quantitative treatment is for the most part lacking, and while a pleasing picture is drawn which is probably true in character, it is usually inadequately furnished with those definite facts which the geographer requires.

I propose, therefore, to examine a little more closely the question of geographical investigation and research in order to see where we stand and in what direction it behooves us to put forth our energies to the end that a branch of knowledge which is of

such importance shall rest upon that basis of detailed study and investigation which alone can supply the starting-point for further advance. The intricate and complicated character of the subject, the extent of its purview, the numerous points at which it touches and imperceptibly passes into other well-defined branches of knowledge, render the study of geography very liable to degenerate into a purely descriptive treatment of the earth's surface and all that is to be found thereon, rather than to follow the narrow path of scientific progress in which the careful collection of data furnishes the material for systematic discussion and study in order that trustworthy generalizations may be reached.

The opportunity to undertake long journeys through distant lands comes to a few of us, but this is not the only direction in which research can be profitably undertaken, for there is no part of these islands where a geographer can not find within his reach some geographical problem which is well worth working out, and which, if well and thoroughly done, will be a valuable contribution to his science. Even for such as can not undertake such field work the library will provide a host of subjects which have not received nearly the amount of attention and of careful study that they deserve. The one thing essential is that the study should be as thorough as possible, so that all the contributory lines of evidence shall be brought together and compared, and so that the result may prove to be a real addition to geographical science on which other workers may in their turn build.

For those who desire to undertake such investigations there is at any rate no lack of geographical material, for travelers, explorers, and others engaged in various occupations in every part of the world are continually recording their experiences

and describing their surroundings in books and pamphlets; they recount their experiences to the Geographical Societies, who apparently have no difficulty in obtaining communications of wide interest for their meetings. Most portions of the British Empire as well as regions belonging to other nations are in these days more or less fully examined, surveyed and investigated with a view to their development, and those who undertake such work have ample opportunities for the most part for preparing descriptions of the lands in which they have sojourned and with which they are well acquainted. But although the material is so ample the quality of it is not generally such as makes it suitable for an adequate study of the phenomena or the region to which it relates. The ease with which a tract of country or a route can be described by the traveler, and the attractiveness of such a description of a little-known region, results in the provision of a vast quantity of geographical information, the greater part of which has probably been collected by those who have no adequate training in the subject. In such cases it is not uncommon for the writer to disclaim any geological or botanical knowledge, for instance, but the great majority of those to whom the opportunity is given to travel and see new lands and peoples are fully convinced of their competence to describe accurately and sufficiently the geography of the regions which they traverse. But any one who has had occasion to make use of such material in a serious investigation is only too well aware how little precise and definite information he will be able to extract from the greater part of this wealth of material, and in most cases this is due to the traveler's lack of geographical knowledge. He probably does not know the phenomena which should be observed in the type of region which he is

traversing, nor can he read the geographical evidence which lies patent to a trained observer at every point of the journey; much, therefore, of what he records may be of interest, but probably lacks data which are essential to the geographer if he is to understand the geographical character of the region and utilize it properly.

Thus it happens that although the amount of geographical material which is being garnered may be large, the proportion of it which is available for use in a scientific investigation of an area is smaller than is probably realized by those who have not made the experiment. And yet it is only by this scientific investigation of selected localities or of a single phenomenon and by working them out as thoroughly as possible that any real advance in geographical science can be made. The accounts of such pieces of work will not appeal to those who desire picturesque descriptions of little-known lands, but they will be welcomed by geographers who can appreciate the value of such studies. There should now be an ever-increasing number of such geographers, trained to proceed in their investigations by the true scientific method, and there should be a very considerable amount of sound work in various branches of the subject which aims at thoroughly investigating some phenomenon, or group of phenomena, so as to present a grouping of data, carefully verified and critically discussed, in order to arrive at conclusions which may form a useful addition, however small, to the sum of our geographical knowledge.

So far as I am able to judge, the output of serious work of this character is not nearly as large as it should be, and I would indicate some fields in which there is a lack of individual work of this character. Until more of it is undertaken we shall lack in this country the material from which the foundation of scientific geography can be

built up, and while our own islands and the various parts of the British Empire furnish unrivalled opportunities for such work, there are still far too many subjects where the most thorough investigations have been made in other countries.

Mathematical geography presents a field for research which had comparatively little attention paid to it in this country. In many respects this part of the subject is peculiarly suitable for such treatment, since it admits of the employment of precise methods to an extent which is not always practicable in cases where so many of the factors can only be approximately defined. The determination of positions on the earth's surface is carried to great refinement in the national surveys of most civilized countries in order to furnish the necessary controls for the preparation of large-scale maps, but when we pass to the location of travellers' routes, where considerable allowance has to be made for the conditions under which the observations have to be taken, we find that very inadequate attention is usually paid to the discussion of the results. Usually a mean value for each latitude, longitude or azimuth is obtained by the computer, and he remains satisfied with this, so that when the route of another traveller follows the same line or crosses it at one or more points, it is almost impossible for the cartographer to say which of the two determinations of any position is entitled to the greater confidence. In this class of work, whether the results are obtained from absolute observations at certain points or from the direction of march, and the distance traversed, it is quite practicable to determine the range of uncertainty within which the positions of different points are laid down, and it is eminently desirable that this should always be done in order that the adjustment of various routes which may intersect in partially-known

regions may be adjusted in accordance with definite mathematical processes. Some important expeditions on which infinite labor and considerable sums have been expended have presented their results, in so far as they relate to the routes which have been followed and the position of points which have been determined, in such a way that it is impossible to say within what precision such positions have been determined, and consequently any combination of these results with those of later expeditions has to be carried out empirically, since adequate data are no longer available for the employment of better and more scientific methods.

This crude and unsatisfactory way of treating observations, which in many cases have been obtained under conditions of the greatest difficulty and even hardship, is largely due to the lack of interest which geographers have shown in this part of their subject. Methods of observation and methods of computation are rarely discussed before any of our geographical societies or in any of our publications, and it is only by such discussions that the importance of properly working out the available material at a time when the observer can be consulted on points which are doubtful, or where further explanation is desirable, becomes generally appreciated.

No set of physical or astronomical observations is ever discussed or even presented without the degree of precision or reliability being definitely stated; yet in geography this sound rule is too often neglected.

There are several regions where travelers' routes intersect which should provide ample material for the careful reduction and adjustment of the results. I fear, however, that there would be great difficulty in obtaining the original observations which are indispensable in such an investigation, and in the interest of research it is highly

desirable that the original documents of all work of importance should be preserved and the place where they may be consulted recorded in the published account.

There is room in the geographical investigation of sea and land, even within the limits of the British Empire, for the employment of methods of observation and computation of the highest precision as well as of the simpler and more approximate kinds, but every one who presents the results of his work should deem it his first duty to state explicitly the methods which he employed, and the accuracy to which he attained, in such a form that all who make use of them can judge for themselves of the degree of their reliability.

In such work, while the instruments used are of great importance, too often the briefest description, such as "a 4-inch theodolite," is deemed sufficient. If the observer wishes his work to be treated seriously as a definite contribution to science we require to know more than this, and a clear account of the essentials of the instrument, a statement of its errors, and of the methods of observation adopted are the least that will suffice. The account of any expedition should treat so fully of the instruments, observations and computations utilized to determine the positions of places visited that any one can re-examine the evidence and form his opinion on the value of the results obtained. A mere tabular statement of accepted values, which frequently is all that is provided, is of small value from a scientific point of view. Probably one reason for this state of things is that too little attention is being paid by geographers to their instruments. Theodolites, levels, compasses, clinometers, tacheometers, plane-tables, pantographs, coordinatographs, planimeters, and the many other instruments which are used by the surveyor, the cartographer, the computer, have in no case

arrived at a final state of perfection, but it is seldom that we find a critical description of an instrument in our journals. Descriptions there are from time to time, but these are for the most part weak and insufficient. Not only is a technical description required, which treats fully of both the optical and mechanical details, but we need an extended series of observations with the instrument which have been made under the ordinary conditions of practical work, and these must be mathematically analyzed, and the degree of the reliability of the results clearly demonstrated. The description should be equally thorough and complete, including scale drawings showing the construction of the instrument as well as photographs of it. Nothing less than this is of any use to the scientific cartographer.

While I am on the subject of instruments I would draw attention to the importance of the whole history of the development of surveying instruments. In the latter part of the eighteenth century Great Britain provided the best class of surveying instruments to all countries of Europe, at a time when high-class geodetic work was being commenced in several countries; and about this time von Reichenbach spent a part of his time in this country working in the workshops of Dollond and learning this particular class of work. Upon his return to Bavaria he set up at Munich that establishment which soon provided instruments of the highest class for many of the cadastral surveys which were being undertaken in Central Europe. At Munich there is now a fine typical collection of such instruments, but in this country the early advances of British instrument-makers of surveying instruments are far from being adequately represented in our National Museum in a manner commensurate with their importance. The keen and enlightened zeal of geographers who are interested

in this branch of the subject would doubtless quickly bring to light much still remaining that is of great interest, but which is yet unrecognized, while a closer attention to instrumental equipment would lead to improvements and advances in the types that are now employed. There is no modern work in this country on the development of such instruments, and references to their history are conspicuously rare in our journals, so that there is here an opportunity for those whose duties prevent them from undertaking travel or exploration of a more ambitious kind. In the same way, those whose opportunities of field work are few can find a promising field of study in the early methods and practise of surveying which have been discussed by many authors from classical times onwards, and for which a considerable amount of material exists.

In geodesy and surveying of high precision there is ample scope for all who are attracted by the mathematical aspect of the subject; the critical discussion of the instruments and methods employed and results obtained, both in this country and in other lands, provides opportunity for much work of real value, while its bearing upon geology, seismology, etc., has not yet been adequately treated here. The detailed history of this part of our subject is to be found in papers which have been published in the technical and scientific journals of other countries for the most part; here too little attention has been given to the subject, in spite of the large amount of geodetic work which has been executed in the British Empire, and which remains to be done in our colonies and over-seas dominions.

The final expression of the surveyor's detailed measurements is found in the map, and the adequate representation of any land surface on a map-sheet is both a science and an art. Here we require addi-

tional work on all sides, for there is hardly any branch of geography which offers so remunerative a field for activity as cartography. We need the cooperation of trained geographers to study requirements, and to make acquaintance with the limits of technical methods of reproduction, so that they may be in a position to deal with many questions which arise in the preparation of a map regarding the most suitable mode of presentation of data, a matter which is purely geographical, but which at the present time is too often left to the skilled draughtsman. Neither the compilation nor the reduction of maps are merely mechanical processes. The first requires great skill and care as well as technical knowledge and a sound method of treatment if the various pieces of work, which are brought together to make up the map of any considerable area, are to be utilized according to their true worth. This demands a competent knowledge of the work which has been previously done on the region, a first-hand acquaintance with the data collected by the earlier workers, and the critical examination of them in order that due weight may be given to the better material in the final result. This is not a task to be handed over to the draughtsman, who will mechanically incorporate the material as though it were all of equal accuracy, or will adjust discrepancies arbitrarily and not on any definite plan. Such preliminary preparation of cartographical material is a scientific operation which should be carried out by scientific methods and should be completed before the work reaches the draughtsman, who will then have but to introduce detail into a network of controls which has been prepared for him and of which the accuracy at all points has been definitely ascertained. Similarly in the second case the elimination of detail which must of necessity be omitted is an opera-

tion needing the greatest skill, a full understanding of the material available, and an adequate appreciation of the result which is being aimed at, such as is only to be found in a competent geographer who has made himself intimately acquainted with all the material which is available and has his critical faculty fully developed.

The use of maps has steadily increased of recent years, but we should look forward to an even more widely extended use of them in the future; and this will be greatly facilitated if there are geographers who have made themselves masters of the technique of map reproduction and, as scientific geographers, are prepared to select such data as are needed for any particular class of map on a well-considered method, and not by the haphazard procedure to which the want of a scientific study of cartographic methods must inevitably lead. The paucity of papers dealing with practical cartography and the compilation of maps is clear proof that this branch of the subject awaits far more serious attention than it now receives.

All these problems are well within the reach of the geographer to whom the opportunity of travel in other regions does not come, and in them he will find ready to his hand a field of research which is well worth working and which will amply repay any labor that is spent upon it. The same precise methods of investigation which are employed in the discussion of observations should be applied to all cartographic material in order to ascertain the exact standard of its reliability, in which is included not only the correctness of distance and direction, but also the accuracy of the information which has been incorporated in it; and these may be brought to bear also on those early maps of which so many are preserved in our libraries in this country. In this field of study several investigators



have already achieved results of great interest and value, but I think that they will be ready to admit that there is here a wide and profitable field of activity for many more workers who will study closely these early maps and, not being contented with verbal descriptions, will use quantitative methods wherever these are possible.

In the study of map projections some activity has been visible in recent years, and we may hope that those who have worked in this branch of the subject will see that British geography is provided with a comprehensive manual of this subject which will be worthy of the vast importance of cartography to the Empire. The selection of suitable projections is receiving much more attention than was formerly accorded to it, but the number of communications on this subject which reach geographical journals are few and far between. The subject is not one which can appeal strongly to the amateur geographer, but its importance renders it imperative that the scientific geographer who realizes its intimate bearing upon all his work should so arrange that the matter does not fall into the background on this account.

A closer relation and a more active co-operation between those who are prepared to work seriously at cartography and its various problems may reasonably be expected to raise the standard of that class of map which is used to illustrate books of travel, or works descriptive of a region. At the present time the inadequate character of many of the maps and plans which are reproduced in such publications shows clearly that the public demand for maps which have been compiled with a view to illustrating the volume in question is still very ineffective.

The whole subject of cartography, with its component parts of map projection, compilation, reproduction, cartometry and the

history of its development, is so important, not only to the individual geographer but also to the advancement of scientific geography, that we should aim at fostering it and encouraging the study of it in every way, and it will be the zeal of individuals rather than the benevolent aid of institutions which will achieve this.

But it may be suggested that the lack of activity in mathematical geography is due to the somewhat specialized nature of the subject, and to the fact that the number of those who have received an adequate mathematical training and are prepared to devote themselves to geography is few. When we turn to physical geography in its treatment of the land we do find a field which has been more actively worked, for this is just the one to which the traveller's and explorer's observations should contribute most largely, and where therefore their material should be utilized with the best results. Even here there is room for much more work of the detailed and critical type, which is not merely general and descriptive, but starts from the careful collection of data, proceeds to the critical discussion of them, and continues by a comparison of the results with those obtained in similar observations in other regions.

To take a single branch of physical geography, the study of rivers, the amount of accurate material which has been adequately discussed is small. In our own country the rainfall of various river basins is well known through the efforts of a meteorological association, but the proportion of it which is removed by evaporation, and of that which passes into the soil, has only been very partially studied. Passing to the run-off, which is more easy to determine satisfactorily, the carefully measured discharges of streams and rivers are not nearly so numerous as they should be if the hydrography of the rivers is to

be adequately discussed; for although the more important rivers have been gauged by the authorities responsible for them in many cases, the results have usually been filed, and the information which has been published is usually a final value but without either the original data from which it has been deduced, or a full account given of the methods of measurement which have been employed. For the requirements of the authority concerned such a record is no doubt adequate, but the geographer requires the more detailed information if he is to coordinate satisfactorily the volume discharged with local rainfall, with changes in the rates of erosion or deposition, and the many other phenomena which make up the life-history of a river. Here too it is usually only the main stream which has been investigated; the tributaries still await a similar and even fuller study. A valuable contribution to work of this kind exists in the hydrographical study of the Medway and of the Exe which has been undertaken, by a committee of the Royal Geographical Society during recent years, and this may serve as a guide to other workers; but, however welcome such a piece of work may be, I should much prefer to see the hydrography of a tributary of a river system worked out by a geographer as a piece of individual work, just as the geology or the botany or the zoology of a single restricted area is investigated by those whose interests are centered in these subjects.

In the same way we still know too little of the amounts of the dissolved and suspended matter which is carried down by our streams at various seasons of the year and in the different parts of their course. This class of investigation does not need very elaborate equipment, and may provide the opportunity for much useful study, which may be extended as infor-

mation is increasingly acquired. In this way when numerous individual workers have studied the conditions prevailing in their own areas, and traced them through their seasonal and yearly variations, we shall possess a mass of valuable data with which we may undertake a revision of the results which have been arrived at in past years by various workers from such data as were then at their disposal.

In this one branch of the subject there is ample scope for workers of all interests in the measurement of discharges, in the determination of level, and of the movement of flood waves, in determining the amount of matter transported both in suspension and in solution, in tracing out the changes of the river channel, in following out the variation of the water-table which feeds the stream, in ascertaining the loss of water by seepage in various parts of its course, and generally in studying the hundred other phenomena which are well worth investigating, and which give ample scope for workers of all kinds and of all opportunities. There is work not only in the field, but also in the laboratory and in the library which needs doing, for the full account of even a single stream can only be prepared when data of all classes have been collected and discussed.

On the Scottish lakes much valuable scientific work has been done, and also on some of the English lakes, so that excellent examples of how such work should be done are available as a guide to any one who will devote his spare time for a year or two in making a thorough acquaintance with the characteristics and phenomena of any lake to which he has access.

Coast-lines provide another class of geographical control which repays detailed study, and presents numberless opportunities for systematic investigation and material for many profitable studies in geog-

raphy. The shores of these islands include almost every variety of type, and furnish exceptional opportunities for research of a profitable character, especially as lying on the border-line between the domain of the oceanographer on the one hand and the physiographer on the other. The precise methods of representation which are possible on the land have to give way to a more generalized treatment over the sea, and the shore line is liable to be handed over to the latter sphere, so that there is much interesting and useful work open to any one who will make an accurate and detailed study of a selected piece of coast-line, coordinating it with the phenomena of the land and sea, respectively.

The teaching of Professor Davis in pressing for the employment of systematic methods in describing the landscapes with which the geographer has to deal has brought about a more rational treatment, in which due recognition is given to the structure of the area, and the processes which have moulded it, so that land forms are now for the most part described more or less adequately in terms which are familiar to all geographers and which convey definite associated ideas, in the light of which the particular description is adequately appreciated. It has been urged by some that such technical terms are unnecessary and serve to render the writings in which they occur intelligible only to the few; that any one should be able to express his meaning in words and sentences which will convey his meaning to all. There is no great difficulty in doing this, but in such descriptions to convey all that a technically worded account can give to those who understand its terms would be long and involved on account of the numerous related facts which would be included. It is consequently essential in all accurate work that certain terms should have very

definite and restricted meanings, and such technical terms, when suitably chosen, are not only convenient in that they avoid circumlocution, but when used in the accepted sense at once suggest to the mind a whole series of related and dependent conditions which are always associated with it.

The compilation of a glossary of geographical terms has been in progress in this country for many years without having reached finality, and much of the difficulty which has been experienced is doubtless due to the fact that so many words have not been consistently used with a well-defined meaning. Such looseness of expression is more liable to occur in the case of foreign words which have been imported in the first case by writers who are not scientifically trained, and therefore do not use them in connection with a specified set of conditions. This, however, is unimportant if only scientific geographers, when they accept a term as a desirable addition to the geographical vocabulary, will associate it definitely with such conditions and use it consistently in that connection. As an instance I may quote the word "sadd," which etymologically means to block, or stop. This term was naturally and reasonably used to indicate masses of uprooted marsh vegetation which had been carried along by the current and, if checked at a sharp bend or a narrow point of the stream, blocked the channel. So long as it is used in this restricted sense it is a useful term to describe a phenomenon which occurs under certain definite conditions and which leads to equally well-defined geographical results. This use of it is associated with a meandering river-channel in an alluvial flood plain, where shallow lagoons occur, in which such marsh vegetation grows luxuriantly; when this vegetation is uprooted by storms and car-

ried by the rising water into the main stream it provides the drift material which makes up the block or "sadd."

But this term has been extended immoderately to mean the region in which these physical conditions occur, or the type of vegetation which grows under these conditions, and even the type of country where such conditions prevail. One writer has even used the word in describing the fossil vegetation of a character such as is associated with marsh lands.

The crystallization of such geographical terms into true technical terms is an important step in the furtherance of scientific geography, but it must be done by the geographers themselves, and no means of doing this is more fruitful than the work of original research and investigation in definite areas or on specific problems.

It would take too long to discuss each branch of physical geography and indicate the opportunities for individual effort, but what has been said of one may be said of all the others. Not only in all parts of the Empire, but in these islands also there is ample opportunity for the detailed geographical study of single localities or individual phenomena, just as much as in geology, in botany, or in zoology; and it is these separate pieces of work which, when thoroughly carried out and critically discussed, provide the material on which wider generalizations or larger investigations can be based. Herein lies, therefore, the importance of the prosecution of them by as many workers as possible, and the value of communicating the results to others for criticism and for comparison with the results which they have obtained; for such work, if it can not be made accessible to other workers in the same and related fields, loses a large proportion of its value.

If we now consider some of the problems of human geography we shall find the need

for such systematic study to be even greater; for the variable factors involved are more numerous than in physical geography, and many of them are difficult to reduce to precise statement; the quantitative study of the subject is therefore much more difficult than the qualitative or descriptive, so that the latter is too frequently adopted to the exclusion of the former. The remedy lies, I believe, in individual research into special cases and special areas where the factors involved are not too numerous, where some of them at least can be defined with some accuracy, and where, consequently, deductions can be drawn with some precision and with an accuracy which gives grounds for confidence in the result. The settlements of man, his occupations, his movements in their geographical relations are manifested everywhere, and subjects of study are to be found without difficulty, but their investigation must be based on actual observation, and on data which have been carefully collected and critically examined, so that the subject may be treated as completely as possible, and in such a way that the evidence is laid before the reader in order that he may form his own conclusions.

It is probable that some of the lack of precision which is to be found in this part of the subject is to be attributed to the want of precision in its terminology. For many things in human geography good technical terms are required, but these must be selected by those who have studied the type or phenomenon concerned and have a clear idea of the particular conditions which they desire to associate with the term; this is not the work of a committee of selection, but must grow out of the needs of the individual workers.

There is, it must be admitted, no small difficulty in using the same preciseness of

method in this portion of the subject as is readily attainable in mathematical geography, and is usually practicable in physiography; but at any rate it is undesirable to indicate any condition as the controlling one until all other possible influences have been carefully examined and have been shown to have less weight than that one which has been selected.

Whether the investigation deals with the settlements of man or his movements and means of communication it is important that in the first instance problems of a manageable size should be undertaken and thoroughly treated, leaving larger areas and wider generalizations until a sufficient stock of thoroughly reliable material which is in the form in which it can properly be used for wider aims is available.

The relation of geographical conditions to small settlements can be satisfactorily worked out if sufficient trouble is taken and all possible sources of information, both of present date and of periods which have passed away, are utilized. Such studies are of a real value and pave the way to more elaborate studies, but we need more serious study of these simpler cases both to set our facts in order and to provide a methodical classification of the conditions which prevail in this part of the subject. Out of such studies there will grow such a series of terms with well-defined associations as will give a real precision to the subject which it seems at the present time to lack.

The same benefit is to be anticipated from detailed work in relation to man's communications and the interchange of commodities in all their varied relations. Generalized and descriptive accounts are readily to be found, and these are for the most part supported by tables of statistics, all of which have their value and present truths of great importance in geography,

but the spirit of active research which aims at clearing up thoroughly a small portion of the wide field of geographical activities has unequalled opportunities in the somewhat shadowy relations between the phenomena which we meet in this part of the subject, for focusing the facts better, and obtaining a more exact view of the questions involved.

Where the geography of states (political geography) is concerned the same need for original investigation as a basis for generalizations may be seen. At the present time there is much said about the various boundaries of states, and in general terms the advantages and disadvantages of different boundaries under varied conditions can be stated with fair approximation to accuracy. But I do not know of many detailed examinations of these boundaries or portions of them where full information of all the factors involved can be found set out in an orderly and authoritative manner, thus forming a sure foundation for the generalized description and providing the means of verifying its correctness or revising it where necessary.

Perhaps there is really more scientific research in geography being undertaken by individuals than I have given credit for, but certainly in geographical periodicals, and in the bibliographies which are published annually, the amount shown is not large; neither is the number of authors as large as might be expected from the importance and interest of the subject and from the activity of those centers where geography is seriously taught. There seems to be no reason why individual research on true scientific lines should not be as active in geography as it is in geology, botany, zoology, or any other branch of knowledge; and, just as in these, the real advance in the subject is dependent on such investigations rather than on travels and explora-

tions in little-known lands, unless these too are carried out scientifically and by thoroughly trained observers who know the problems which there await solution, and can read the evidence which lies before them on their route.

If research in these directions is being actively prosecuted, but the appearance of its results is delayed, let us seek out the retarding causes if there be any, and increase any facilities that may be desirable to assist individual efforts.

Short technical papers of a thoroughly scientific character, such as are the outcome of serious individual research, are, of course, not suitable for those meetings of geographical societies where the majority of the fellows present are not scientific geographers, but should be presented to small meetings of other workers in the same or allied fields, where they can be completely criticized. The reading, discussion and the publication of papers of this class are for geography a great desideratum, for it is in them and by them that all real advance in the subject is made, rather than by tales of travel, however interesting, if these are not the work of one trained in the subject, having a knowledge of what he should observe, and of what his predecessors have done in the same field. The regional aspect of geography in the hands of its best exponents has given to young geographers a wide and comprehensive outlook on the interaction of the various geographical factors in a region, the responses between the earth's surface and the life upon it, and the control that one factor may exercise upon another. In this form the fascination of geographical study is apparent to every one, but I sometimes wonder whether the exposition of such a regional study by one who is thoroughly master of the component factors, having a first-hand knowledge of all the material involved, and knowing exactly the reliability of each por-

tion, impresses sufficiently upon the student the necessity of personal research into the details of some problem or phenomena in such a way as to gain a real working acquaintance with them; or does it on the other hand tend to encourage generalizations based on descriptive accounts which have not been verified, and where coincidences and similarities may be accepted without further inquiry as evidence of a causal connection which may not really exist? I imagine that the student may be attracted by the apparent simplicity of a masterly account of the geographical controls and responses involved, and may fail to realize that geographical descriptions, even though technically phrased, are not the equivalent of original quantitative investigation, either for his own education or as a contribution to the subject.

For these reasons I believe that societies can do far more good in the promotion of geography as a science by assisting competent investigators, by the loan of books and instruments, and by giving facilities for the discussion and publication of technical papers, than by undertaking the investigation of problems themselves.

Among the earlier presidential addresses of this section some have laid stress on the importance of the recognition by the state of geography in education; others have represented the great part which the geographical societies have played in supporting and advancing the subject; others again have urged the fuller recognition of geography by educational institutions. I would on this occasion attach especial importance to the prosecution of serious research by individuals in any branch of the subject that is accessible to them, to the discussion of the results of such work by others of like interests, and to the publication of such studies as having a real value in promoting the advancement of scientific geography.

H. G. LYONS